1st Mars 2020 Landing Site Workshop - Introduction

John Grant and Matt Golombek

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Guiding Principles:

- Landing site selection is critical to all aspects of 2020 mission and program success (no landing, no science)
- Final site recommendation, selection, and approval is the job of the Project, 2020 Science Team, and NASA HQ, respectively.
- ***The broad expertise of the science community is crucial to the identification of optimal sites.***
- Process is open to all and has no predetermined outcome

Basis for 2020 Site Selection:

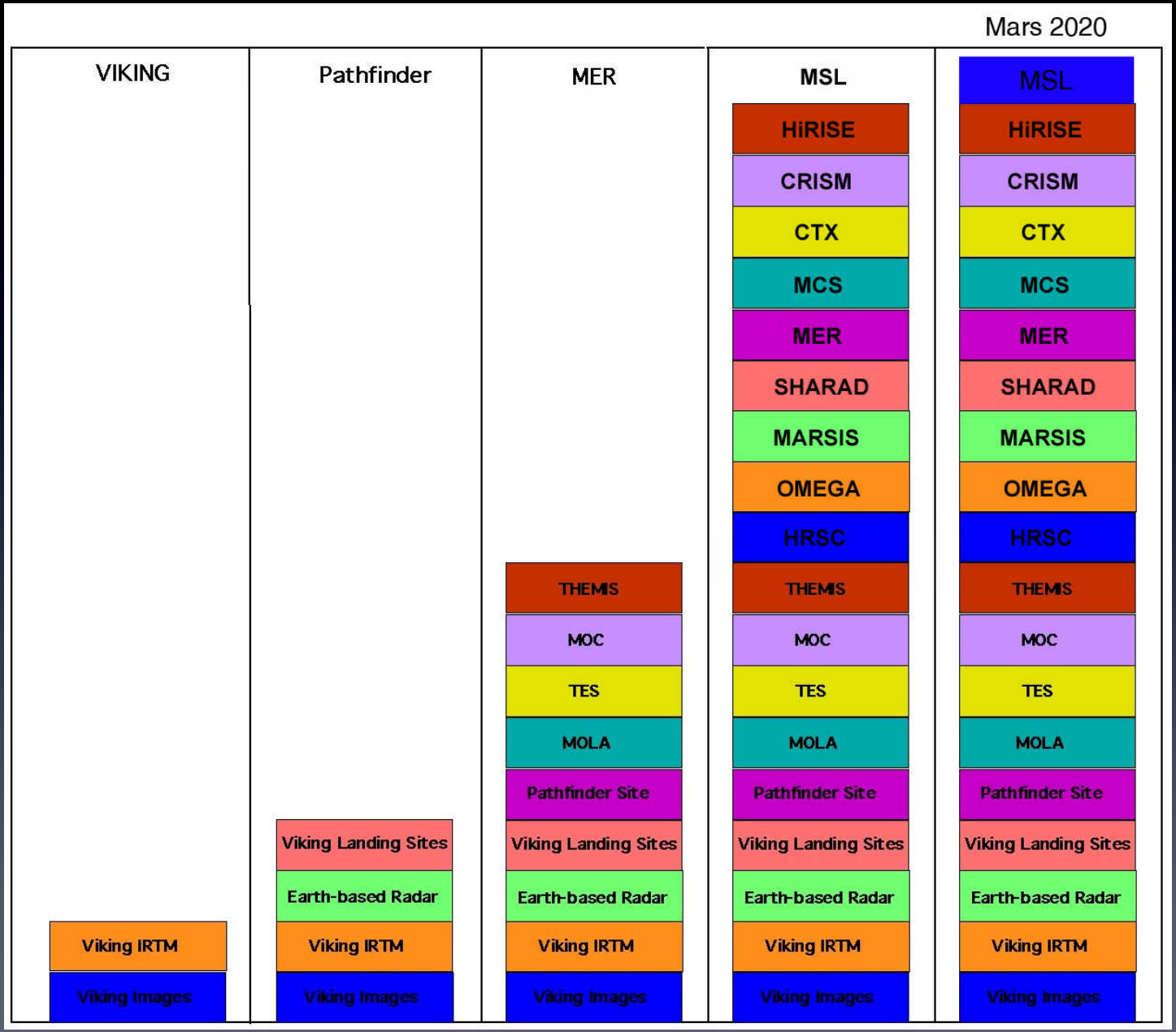
- Site Must Meet **All** Engineering Requirements
- Selected Sites Are Best Suited to Achieving 2020 Mission Science Objectives:
  - ✓ Astrobiologically Relevant Environment
  - ✓ Preserve Information to Understand Geological Record – Including Habitability and Preservation Potential
  - ✓ Preserve Materials Preserve Potential Biosignatures
  - ✓ Assemble Sample Cache – Include Igneous Rocks
  - ✓ Consistent with “Technology” Elements

Participants in 2020 Landing Site Selection:

- **Science Community Input**
  - Broad e-mail distribution, Workshop Attendance, Websites
- **Additional Members**
  - Blend Experience and Mission Involvement
  - Provides for Feed-back on Process
- **NASA-Appointed Landing Site Steering Committee**
  - Co-chairs Grant and Golombek
  - Other Members Appointed by NASA HQ
- **Mars Characterization Investigators** (MDAP, MFRP, CDP)
  - Insight into Landing Site Science and Safety
- **2020 Science Team and Project:**
  - Science Team helps identify and evaluate merits of sites
  - Engineering teams define the engineering constraints and help analyze aspects of the surface and atmospheric environments.
  - Project management and the PSG review scientific analyses of sites.
- **Headquarters and Other Ex-Officios**
  - Ensures broad, relevant MEP participation
  - Access to Ongoing Mission Data
  - Planetary Protection Compliance

- **All Landing Site Selection Activities Documented at:**
  - http://marsnext.jpl.nasa.gov/announcements/index.cfm

Data Sets for 2020 Landing Site Selection:

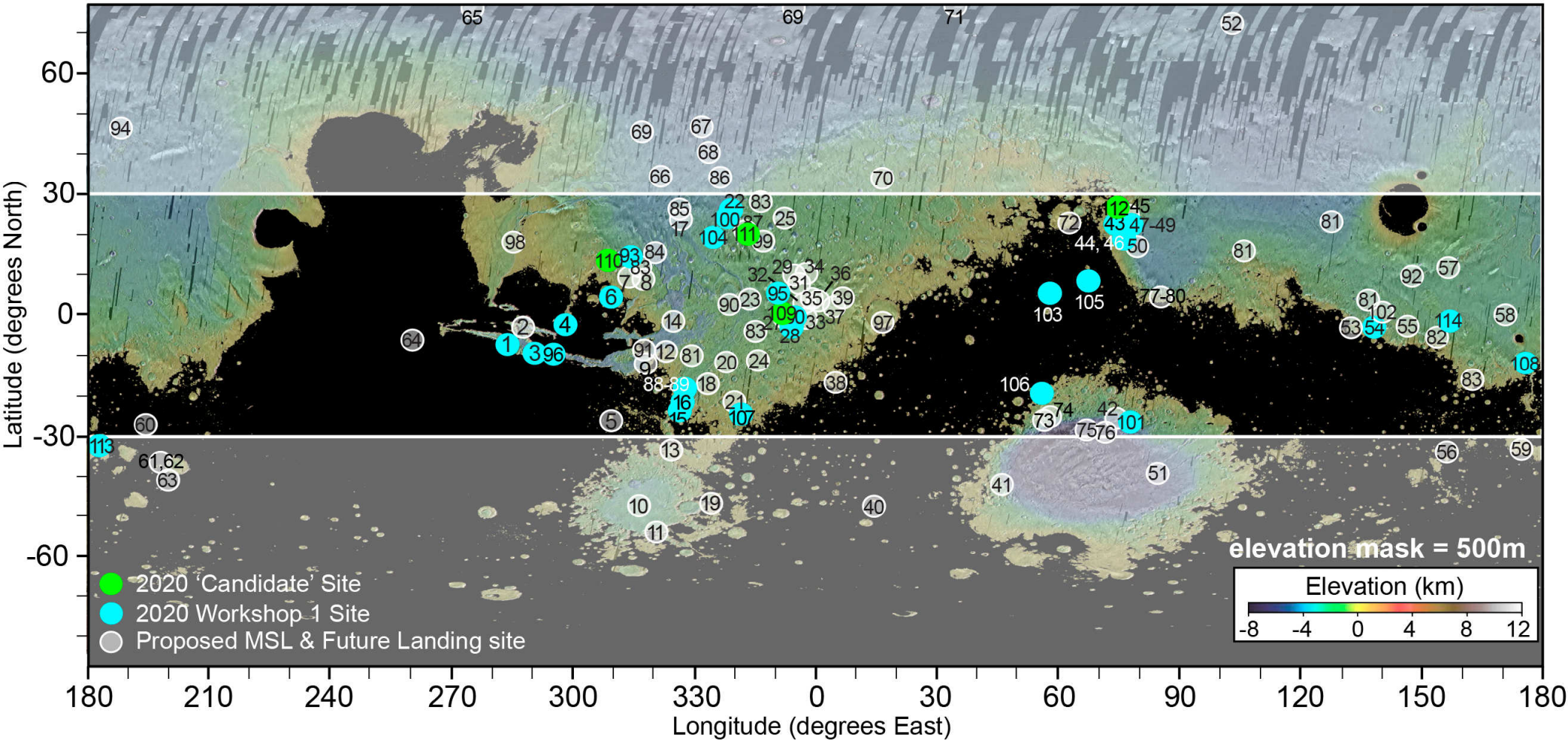


Expect Exhaustive Landing Site Evaluation Process

How Many Future Landing Site Candidates are there?

- Multiple calls (Future Sites, 2018, CDP) for future landing sites have resulted in 55 candidates plus an additional 9 candidates for 2020 (multiple targets at many of these sites)
- Includes a wide range of future mission scenarios
  - Many candidate ellipses are 10 km X 15 km and many are relevant for 2020, but others specified by proposer
  - Most not vetted at workshop, some presented at 1st 2020 Site Workshop.
- Call for Critical Data Products (CDP) V, VI, and VII yielded additional candidates. Most recent CDP did not include call for landing sites.
- Some of these sites not appropriate for Mars 2020 Objectives
- Sites queued for imaging by MRO and other orbital assets
  - A few of remaining sites await CRISM cold cycles
- Mars Steering Committee co-chairs appointed (Grant and Golombek)

All Candidate Landing Sites:

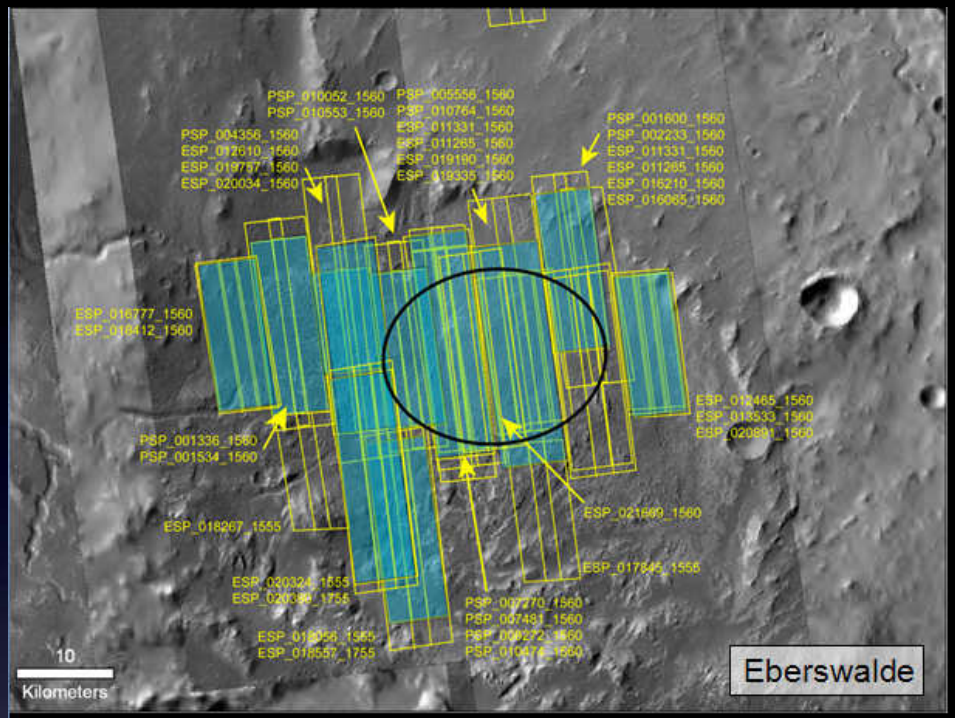


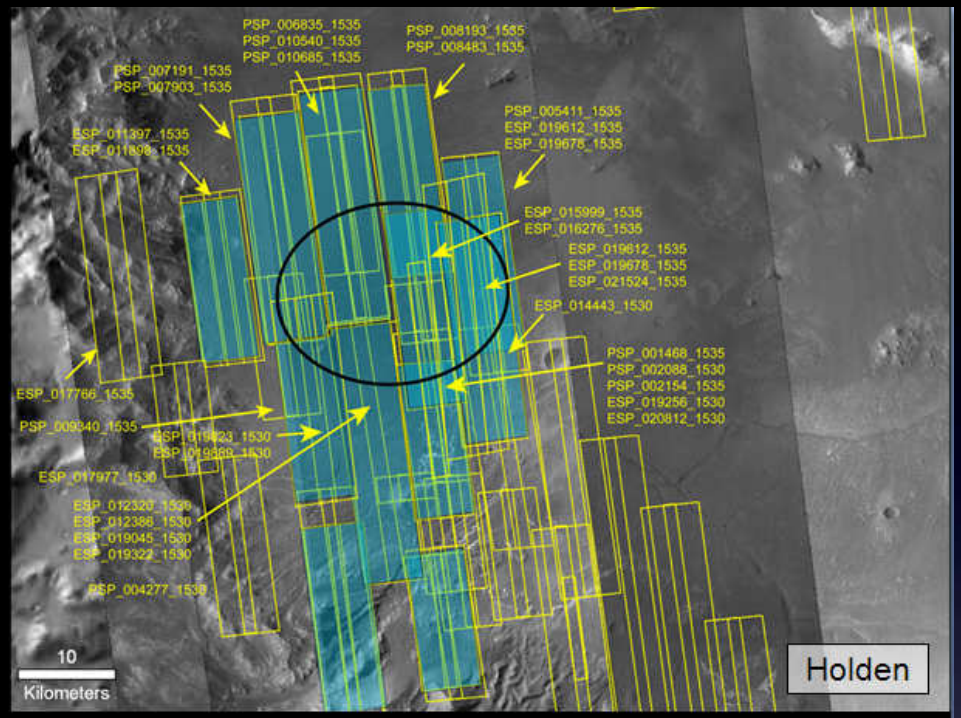
See Mars 2020 SDT Report and Next Slide for Key to Sites:

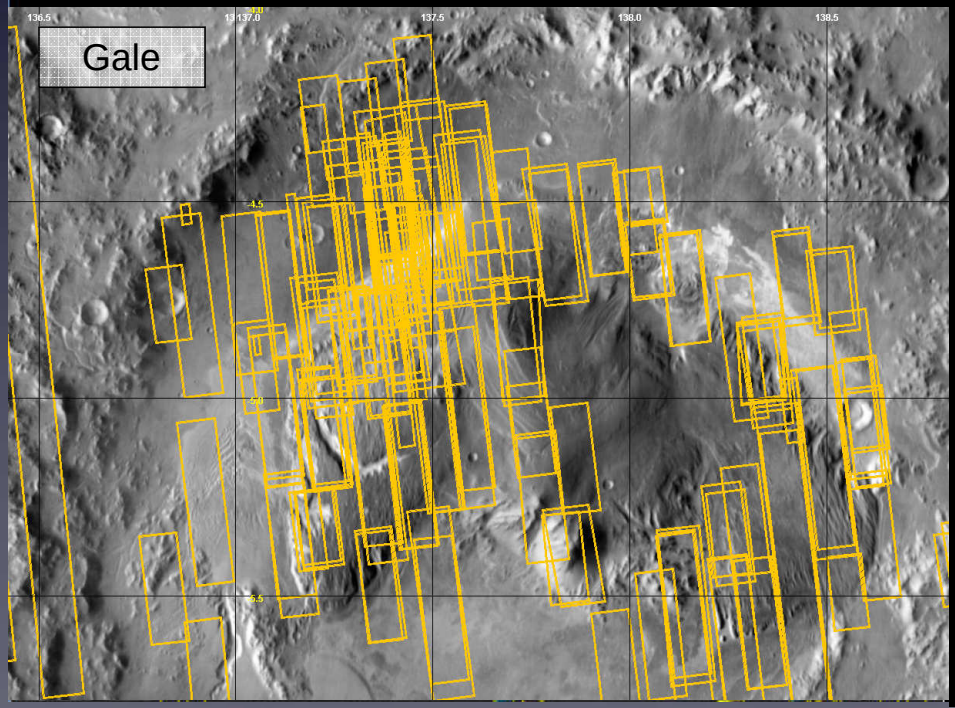
How Many Images Have Been Taken? (Through Feb 2014)

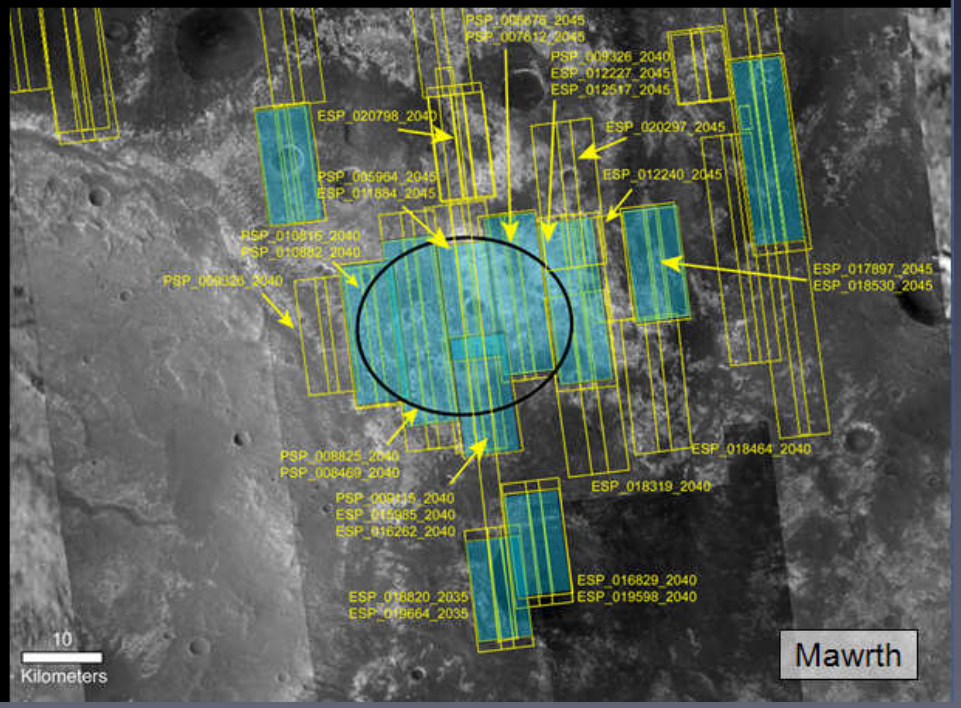
- Total of >510 HiRISE images acquired through Feb for MSL/Future/2018/2020
- 259 HiRISE images acquired of MSL sites
  - Spread around ~65 candidate sites over ~6 years
  - 1 since LTM (12 additional of Gale and vicinity not included in total)
- 64 Future/2018/2020 candidate sites proposed in total
- Range of missions and ellipses
  - Some have appeared before (MER and MSL)
  - Lots of spreadsheets to keep track of…
- Some sites have multiple, prioritized targets
- 251 HiRISE images acquired of future sites/2018/2020
  - ~43 since LTM, mostly 2020 targets remain
  - ~41 HiRISE images left to acquire (includes 2nd half stereo
- CRISM Lead on targets during “cold cycles”
  - ~130 targets acquired IR-cold (includes MSL and E2E reference (remaining are tough)
  - ~100 FRTs at cold temperatures for future landing sites (includes 2020)
  - 13 2020 targets in cold cycle rm 189

Example of Data Coverage for MSL:



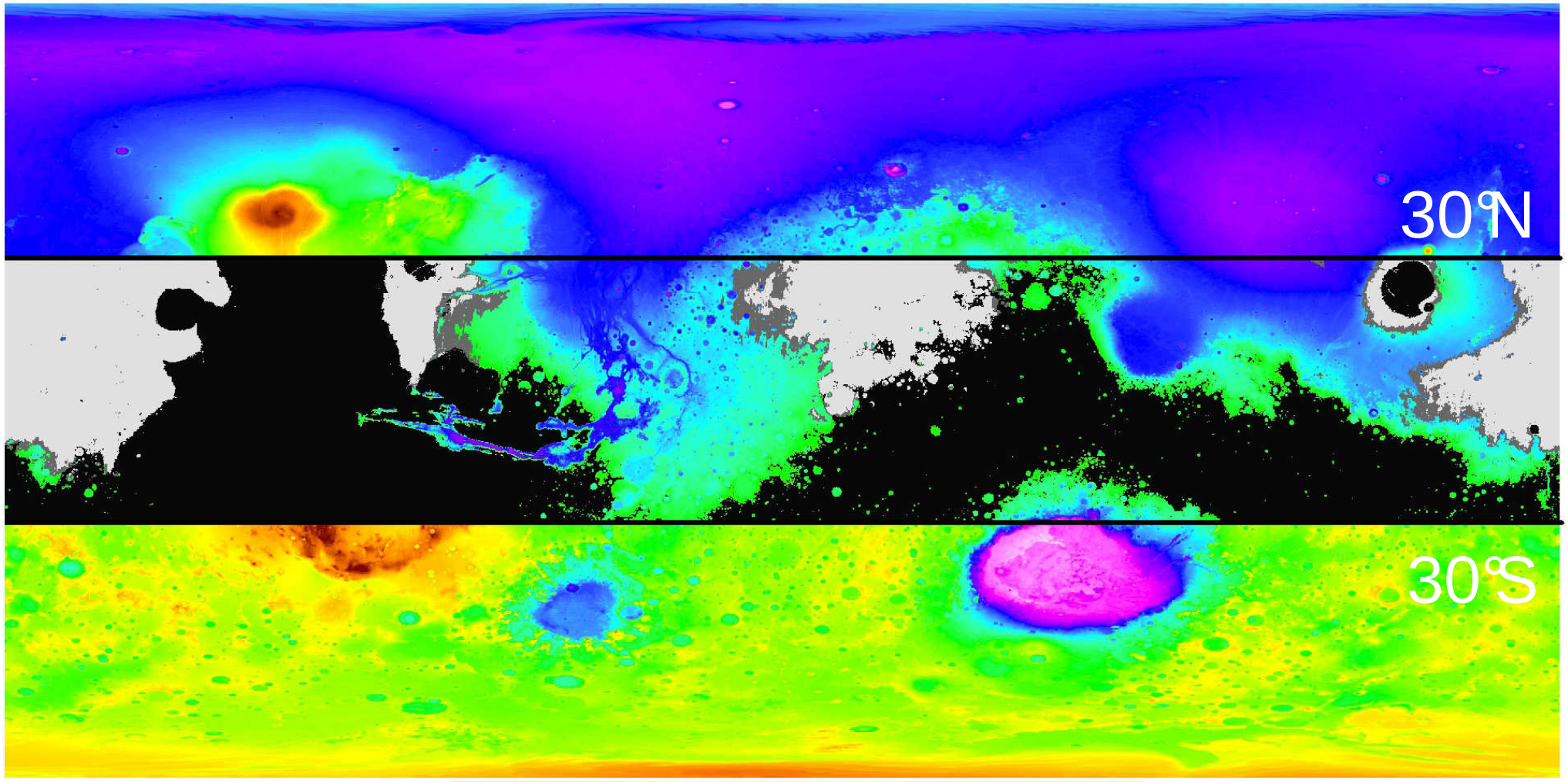






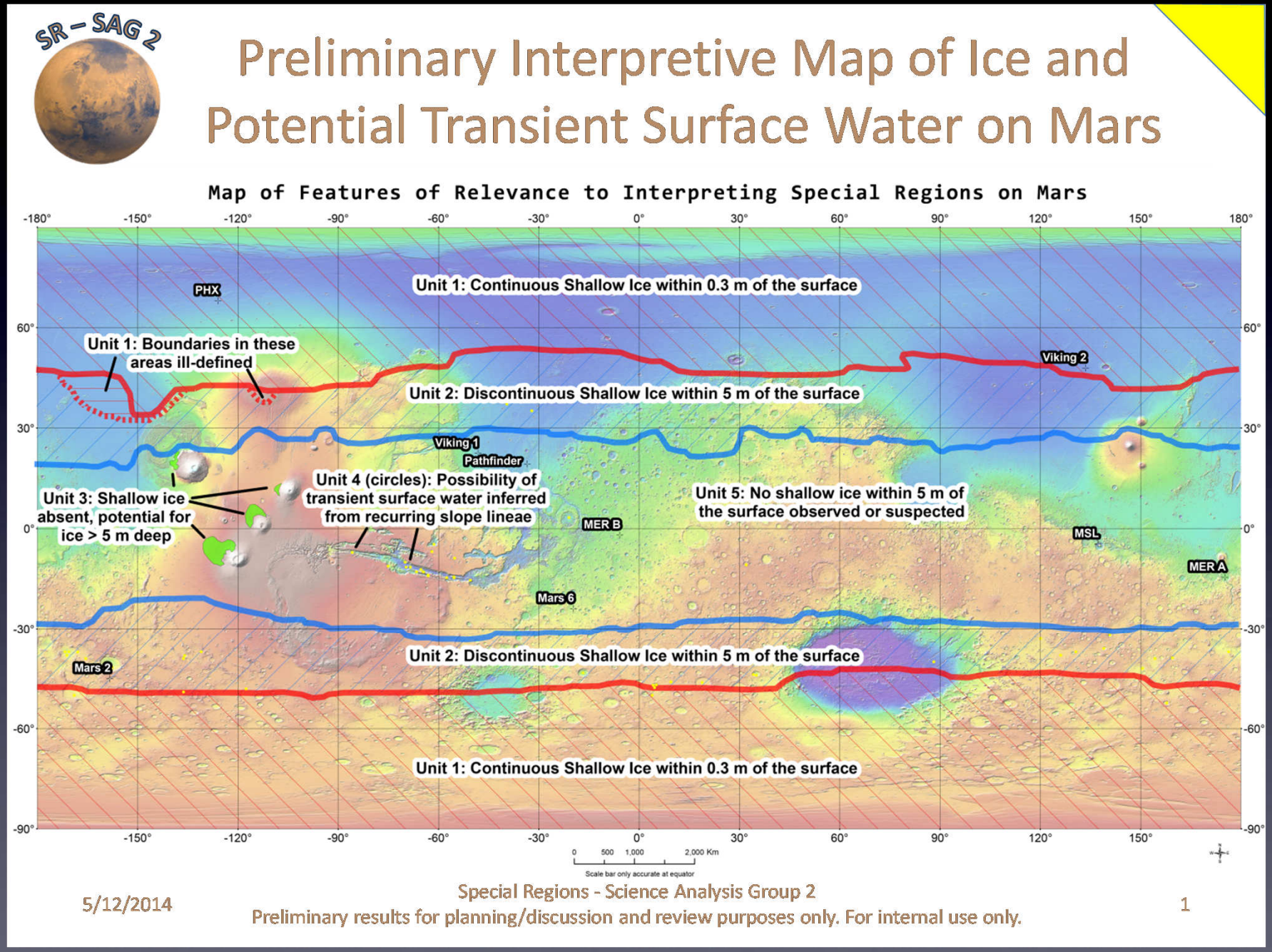
Where 2020 Can Land:
Elevation/Lat. Mask with Values of TES Thermal Inertia

- < 150 = dark gray (Christensen et al. 2001)
- < 100 = light gray



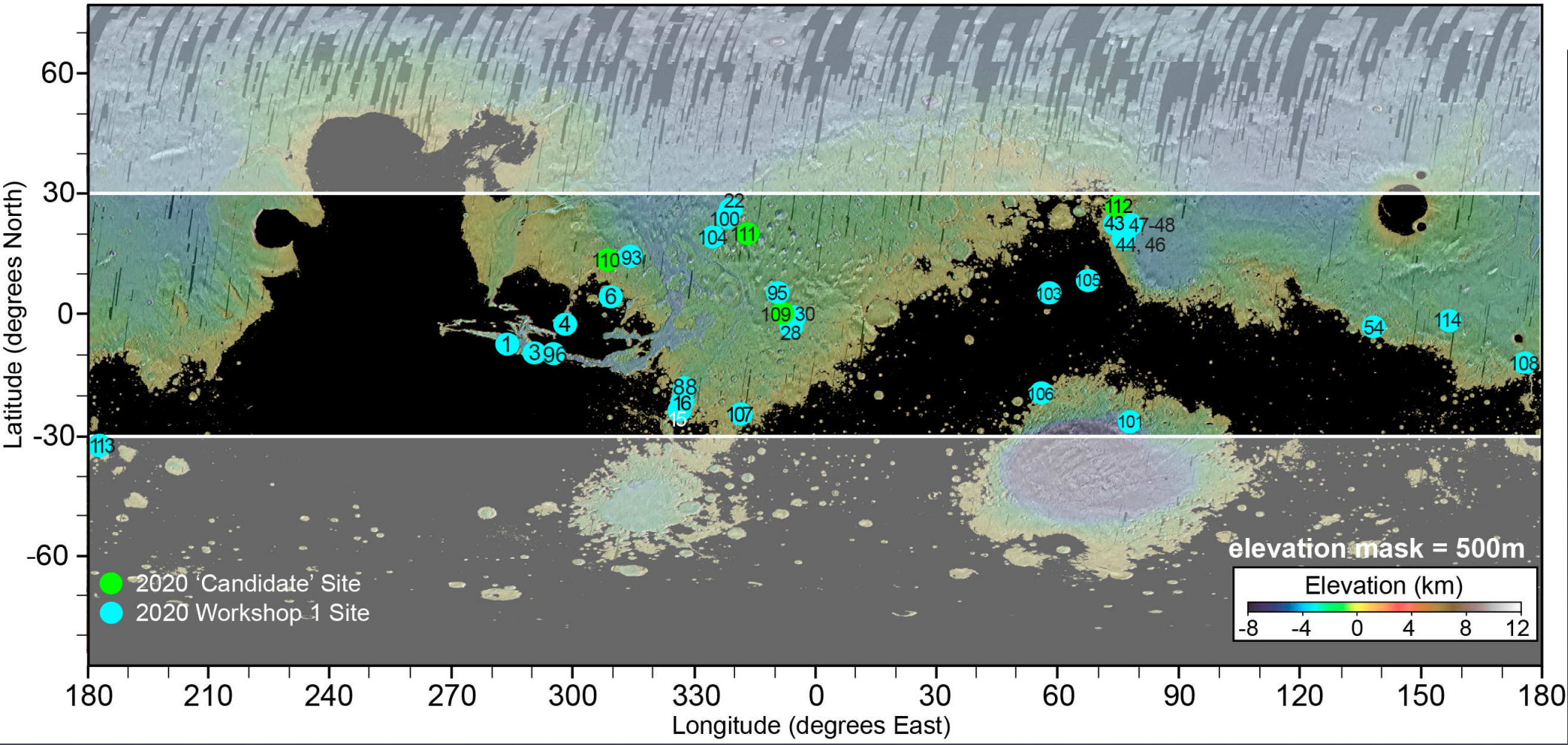
From Matt Golombek

Planetary Protection Considerations:



PPO and 2020 Project agree on requirements, workshop/community adhere to requirements

2020 Candidate Landing Sites:



MARS 2020 WORKSHOP SITES (listed in order of presentation schedule, BLUE DOTS)

Dot 100: McLaughlin Crater (Michalski, J. et al.)
Dot 103: Leighton Crater (Michalski, J. et al.)
Dot 22: Mawrth Vallis (Loizeau, D. et al.)
Dot 104: Oxia Planum (Thollot, P., et al.)
Dot 43: Nili Fossae Trough (Mustard, J. F. et al.)
Dot 48: Nili Fossae Carbonates (Ehlmann, B., et al.)
Dot 44: NE Syrtis Major (Mustard, J. F., et al.)
Dot 105: Nili Patera (Skok, J. R., et al.) *(2020 Candidate Site from Skok, J. R., et al.)*
Dot 106: Hellas (NoeDobrea, E. Z., et al.)
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Dot 4: Juventae Chasma (Miyamoto et al.)
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Dot 96: Coprates Chasma (Quantin, C., et al.)
Dot 6: Hypanis delta in Xanthe Terra (Gupta, S., et al.)
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Dot 54: Gale Crater (Grant, J.)
Dot 30: Meridiani Planum (M. Golombek)
Dot 15: Holden Crater (Irwin, R.)
Dot 114: Aeolis (Yakovlev, V)

MARS 2020 CANDIDATE SITES (GREEN DOTS)

Dot 109: Farthest West Meridiani (Edgett et al.)
Dot 110: Vistula Valles/Chryse (Edgett et al.)
Dot 111: Intercrater West Arabia (Edgett et al.)
Dot 112: Nilosyrtis crater (Saper, L)

Summary of Workshop Deliverables:

- Provide a guide for future imaging of the sites:
  - Rank the candidate sites as high, medium, low based on science priority,
  - Evaluate existing data coverage
- Consider whether candidate sites are “land on” vs. “go to”
- Consider the value of EDL enhancements for access to the candidate sites
  - Range Trigger shrinks landing ellipse, Terrain Relative Navigation (TRN) can help avoid hazards during landing.
  - Discussed in detail during subsequent talks
- No sites eliminated (unless they violate basic engineering criteria).
- Opportunity for new sites to be considered at the second workshop in 2015.

Criteria for Deliverables Chart

- Science Value Relative to 2020 Objectives
  - Astrobiologically Relevant Environment
  - Preserve Information to Understand Geological Record – Including Habitability and Preservation Potential
  - Preserve Materials Preserve Potential Biosignatures
  - Assemble Sample Cache – Include Igneous Rocks
  - Consistent with “Technology” Elements
- Need for Additional Imaging by Orbiters
  - Understanding of Site would benefit from Additional Orbital Imaging
- Is the Site Likely Land On or Go To?
  - Land adjacent and Drive or Land On Material of Prime Interest
- Is Range Trigger Likely Needed for Access?
  - Is Ellipse 16 km by 14 km Required to Land Safely (either Go To or Land On)?
- Does Range Trigger Reduce the Need for TRN?
  - Can Ellipse 16 km by 14 km Fit More Safely than 25 km by 20 km Ellipse?
- Does Access Likely Require TRN?
  - Are areas <110 m Radius that Violate Relief & Rock Constraints Surrounded by Areas >120 m radius that are Safe in Ellipse?
  - Relief >100 m within 1 km; Rock Abundance >8%
- If Go To, Would TRN Make Land On?
  - Can Ellipse be Placed on Material of Prime Interest Safely with TRN?

First Workshop Deliverables:

Candidate Landing Site	Science Value* Relative to 2020 Objectives	Need for Additional Imaging by Orbiters	Is Site Likely Land On or Go To?	Is Range Trigger Likely Needed for Access?	Does Range Trigger Reduce the Need for TRN?	Does Access Likely Require TRN?	If Go To, Would TRN
Mawrth Vallis	High/Medium/Low	High/Medium/Low	Land On/Go To	Yes/No/Maybe	Yes/No/Maybe	Yes/No/Maybe	Yes/No
Oxia Planum							
Nili Fossae Trough							
Nili Fossae Carbonates							
NE Syrtis Major							
Nili Patera Hydrothermal							
Circum-Hellas Hydrothermal							
Valles Marineris							
Southwest Melas Basin							
Coprates Chasma							
Hypanis Delta							
Eberswalde Delta							
Jezero Crater Delta							
Ladon Valles							
Sabrina Vallis							
Eridania Basin							
Kashira Crater							
East Margaritifer Chloride							
Hadriacus Palus							
Gusev Crater							
Gale Crater							
Meridiani Planum							
Holden Crater							
Aeolis							

* Will vote on each site using High (3), Med (2), Low (1)

Current Draft 2020 Landing Site Selection Timeline

4-5 Workshops, 4-5 Years, Possible Selection L-2 or L-1 yr

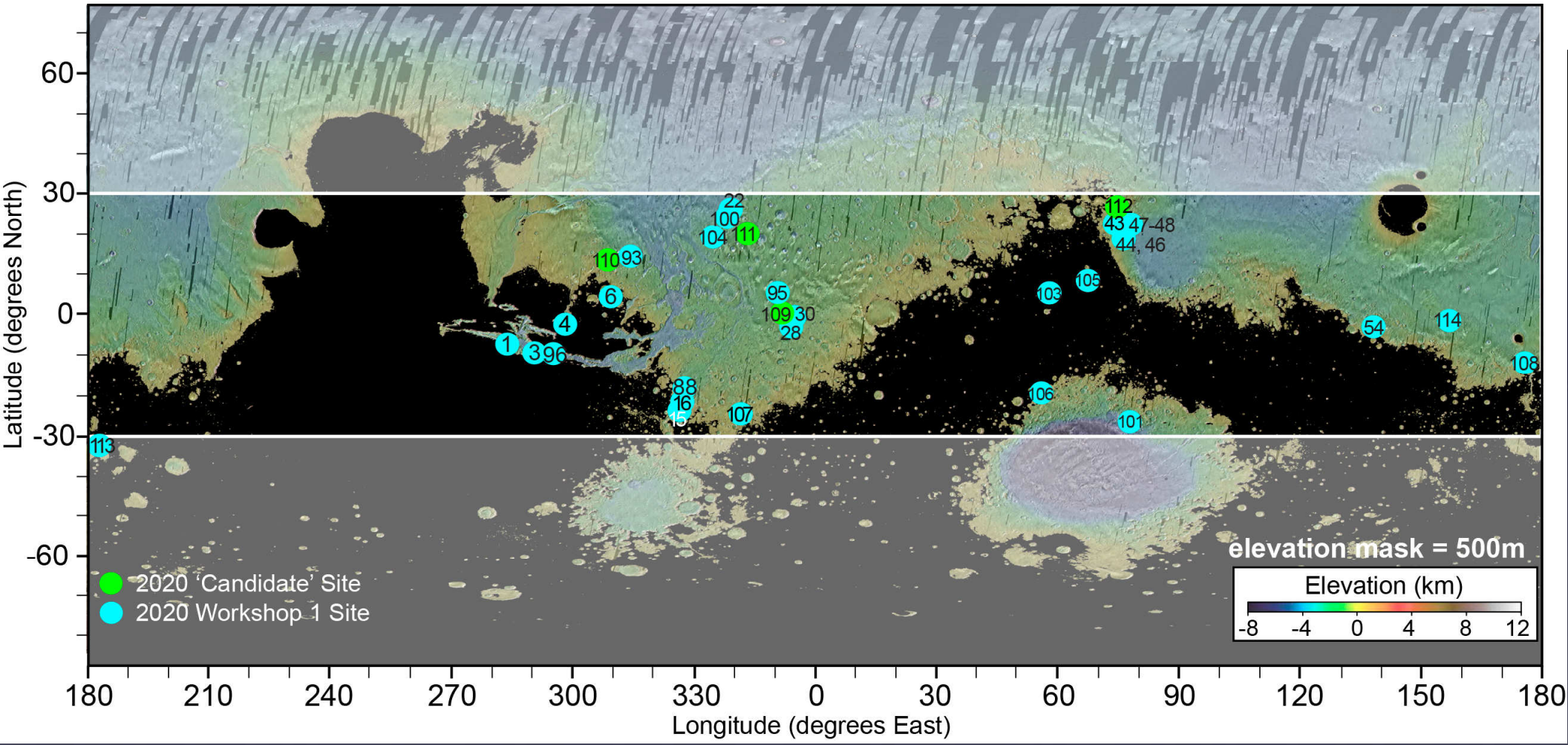
Date	Title	Comments/Description	# of Sites
7/13	SDT report	• Preliminary engineering constraints	
5/14	LSW 1	• Sites prioritized into thirds by science merit • Top 3rd to be characterized for safety and TRN need by LSW 2	~28
6/15	LSW 2	• Identify 4-5 selectable sites - Are there enough non-TRN sites of sufficient science merit? - If not, is TRN required? Define TRN attributes needed	~4-5 "selectable" ~8 total
1/17	LSW 3	• ~Middle of Phase C	~4
6/18	LSW 4	• Final planned workshop	~1
7/18	Site selection	• Decision dependent on number of high priority sites, clustering of sites, programmatic factors	
7/19	LSW 5, if necessary	• Opportunity for LSW 5 if final site wasn't selected in 2018	
7/20	Launch		

From Al Chen

How Many New Images Before the 2nd Workshop?

- Will be imaging on order of 25 sites in next year before 2nd workshop
- Some sites will contain multiple ellipses or are go-to (more images)
- In 12 months, there are 24 2-week planning cycles
- Likely to acquire ~3 images per cycle (reduced compared to historical due to MRO roll limits)
- On order of 70 new HiRISE images before 2nd workshop – need to distribute by site priority
- CRISM targets imaged in bunches every 4th cycle ("cryo-coolers cold")
- Need up to 5 targets from presenters for each candidate sites by June 16, 2014 (can be science and/or ellipse).
- Must be exact coordinates for center of image and indicate whether HiRISE or CRISM is lead.
- Consult with Matt Golombek on questions related to ellipse placement

2020 Candidate Landing Sites:



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